Coded-Wire Tagging of Wild Coho Juveniles from the Keogh River System, 1977 and 1978

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FISHERIES AND MARINE SERVICE

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CODED-WIRE TAGGING OF WILD COHO SMOLTS FROM THE KEOGH RIVER SYSTEM, 1977 and 1978

by

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ABSTRACT

de Hrussoczy-Wirth, V. C. 1979. Coded-wire tagging of wild coho juveniles from the Keogh River system, 1977 and 1978. Fish. Mar. Serv. Man. Rep. 1506: 25 p.

Downstream migrating coho salmon *(Oncohrynchus kisutch)* smolts in the Keogh River, Vancouver Island, British Columbia were fin marked (adipose-only) and tagged (coded-wire nosetag). In 1977, 42,263 smolts were tagged; in 1978, 28,862. Smolt production and migration timing were measured. Age and size sampling indicated that size of smolts varied significantly among tributary streams.

KEY WORDS: coho, salmon, juvenile, smolt, migration, coded-wire tag, tagging, British Columbia, smolt production, age, size.

RÉSUMÉ

de Hrussoczy-Wirth, V. C. 1979. Coded-wire tagging of wild coho juveniles from the Keogh River system, 1977 and 1978. Fish. Mar. Serv. Man. Rep.1506: 25 p.

Lors de leur migration en aval, on a marqué la aux nageoire (adipose seulement) et étiqueté (a l'aide d'une étiquette metallique codée, fixée au museau) des saumoneaus coho *(Oncorhynchus kisutch)* de la rivière Keogh, dans l'Île Vancouver (Colombie-Britanique). En 1977, on a étiqueté 42,263 saumoneaux et, en 1978, 28,862. La production et la migration des saumoneaux ont fait l'objet d'un examen. L'echantillonage selon l'age et la taille révèle que, chez les saumoneaux, la grandeur varie considerablement selon les tributaires.

MOT-CLÉS: Coho, saumon, juvénile, saumoneau, migration, fil de marquage codé, marquage, Colombie-Britannique, production des saumoneaux, âge, taille.

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INTRODUCTION

Coded-wire tagging of wild coho salmon *(Oncorhynchus kisutch)* juveniles has been carried out by the Department of Fisheries and Oceans since 1974. The program has been designed to provide, through tag returns from sport and commercial fisheries, information on the ocean migration and fishery contributions of selected southern British Columbia coho stocks. Reports have been published on the initial tagging projects conducted on the Squamish (Argue and Armstrong, 1977) and the Cowichan (Armstrong and Argue,1977) river systems.

Two factors made the Keogh River particularly suitable for coded-wire tagging of coho salmon: (i) the need to document ocean production parameters for northeast coast Vancouver Island streams, and (ii) the excellent trapping and handling facilities which existed there.

The traps are operated by the Fisheries Research Section of the B. C. Fish and Wildlife Branch which has undertaken a major study program on the Keogh evaluating in-stream enhancement techniques for anadromous gamefish. Results of the long-term Keogh study will be used"... under the Salmonid Enhancement Program for future habitat improvement projects and to improve management of gamefish populations in coastal streams of British Columbia" (Mottram, 1977). One aspect of the provincial program is an on-going census of migrating fish, for which purpose a permanent, mainstem, trapping fence has been installed. Thus Keogh River provided an opportunity to carry out a coho smolt tagging program without the usual cost associated with trapping.

This report presents the results of a tagging project for seaward-migrating coho smolts at Keogh River in 1977 and 1978. The project provided incidental information on the magnitude and timing of coho smolt migrations as well as data on size and age of migrants.

RIVER DESCRIPTION

The Keogh River, on the northeast coast of Vancouver Island, flows through Port Hardy District Municipality, northwesterly into Queen Charlotte Sound. The Keogh is in Department of Fisheries and Oceans Conservation District 5 and Statistical Area 12. Figure 1 shows its location.

An infertile coastal river (Slaney, 1978) of medium size for Vancouver Island, the Keogh is approximately 35 km long with a watershed area of 130 km^2 (Mottram, 1977). Maximum watershed elevation is 1178 m but approximately 80% of the watershed is below 300 m. It is actively logged by both Mac Millan Bloedel Ltd. and Rayonier of Canada Ltd.

Precipitation records at Port Hardy airport, located in the lower portion of the Keogh watershed, indicate a mean annual rainfall of 166 cm in a total precipitation of 173 cm (Mottram, 1977). Recorded flows since 1975 have varied between 225 m^3 (8000 cfs) and 0.08 m^3 (3 cfs) (Slaney, 1978), though during the period of coho smolt migration, flow is less than 14 m^3 (500 cfs) (Slaney, 1975). Daily discharge during downstream migration in 1977 is presented as Appendix K.

FIGURE 1. Keogh River, Vancouver Island, British Columbia, showing locations of trapping fences on tributaries and on mainstem.

The Keogh is a popular sports fishing river, with active coho and resident trout fisheries and a level of steelhead fishing pressure that Slaney (1975) describes as light to moderate. Sports fishing pressure is expected to increase, perhaps greatly, as completion of the North Island Highway opens the northeast coast to large numbers of visiting anglers.

CAPTURE AND TAGGING METHODS

TRAPPING

The Fisheries Research Section of the B. C. Fish and Wildlife Branch has been active on the Keogh River since 1975 in an intensive study of the production and habitat improvement techniques for anadromous game fish (Mottram,1977).

During the springs of 1977 and 1978, the periods of coho tagging by the Department of Fisheries and Environment, the Fish and Wildlife Branch was trapping smolts at fences in five locations on the Keogh system (Fig. 1). Design and construction of the main fence known as Trap No. 1 or T1, are detailed by Mottram (1977) and are shown in Figures 2, 3, and 4. The other four fences, Muir Trap (T2), West Tributary Trap (T3), Misty Trap (T4), and O'Conner Trap (T5) are all similar in design and construction to T1.

Wolf type traps were used at T1 in 1977 (Fig. 5), while in 1978 a horizontal screen system replaced the Wolf traps at the T1 overflow fence (Figs. 6 and 7). Also in 1978 a stop log fence was installed in place of the proposed foot bridge shown in Figure 2. Traps at T2, T3 and T4 were all of the Wolf type, while the horizontal screen system was used at T5 in both years.

In 1977, Wolf traps at T1 began fishing early in March. The first coho smolt was captured on March 11; the last was captured on June 26. In 1978, the T1 horizontal screen trap was fishing by March 19, and the Wolf traps were operating on March 22. The first coho smolt was caught on March 20, and the last on June 24.

HOLDING FACILITIES

For the purposes of tagging, Fish and Wildlife personnel at T1 placed captured coho smolts in holding boxes identical to those described by Armstrong and Argue (1977). Five boxes were joined together and buoyed using styrofoam strips sandwiched between them.

In 1977 the holding box assembly was loosely tied to a walkway and to a corral of 2 x 4's driven into the streambed along the south bank above the main fence (Fig. 4). In 1978 the boxes were installed adjacent to the horizontal screen because it was anticipated that the majority of smolts would be captured in that trap (Fig. 7).

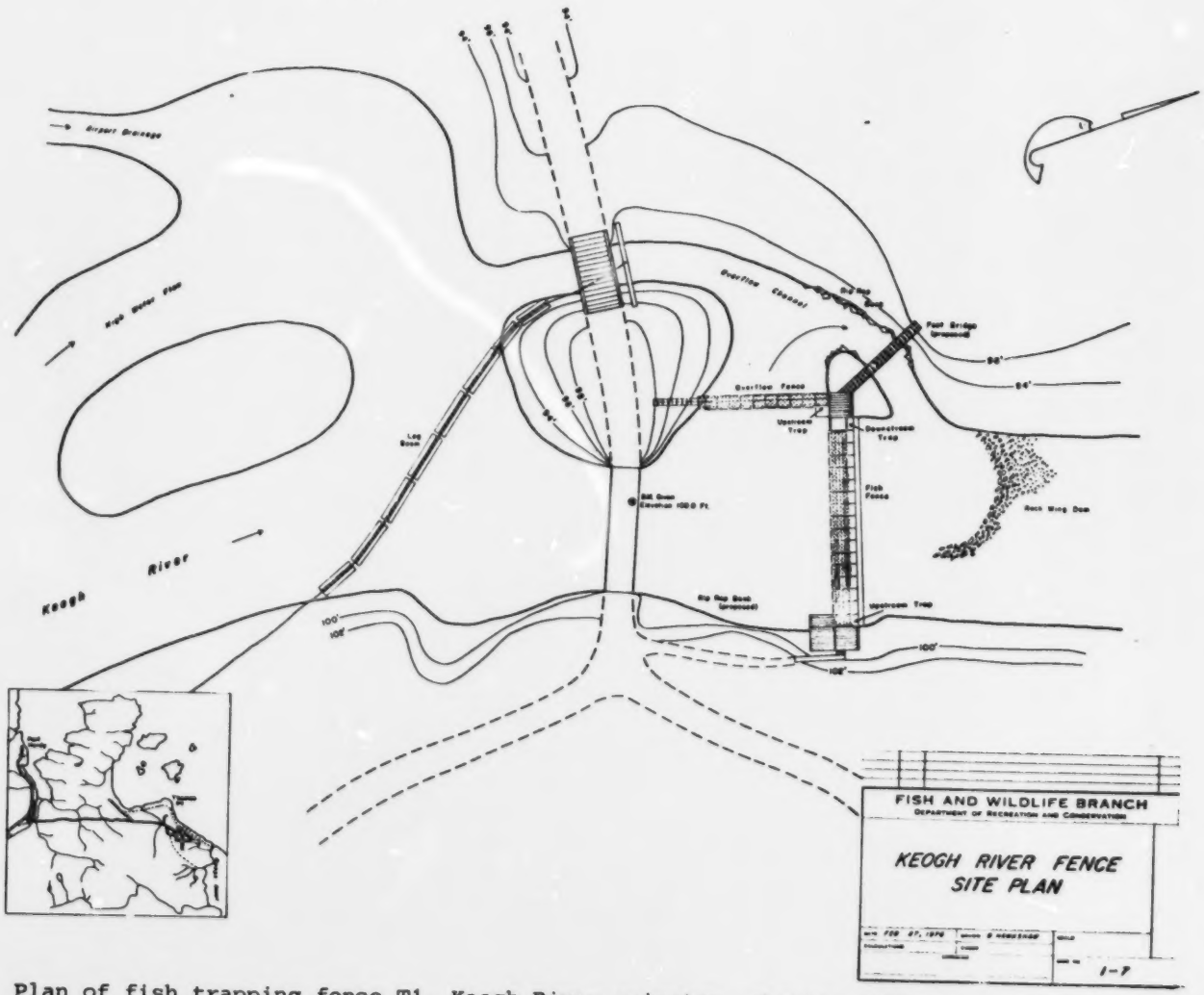

FIGURE 2. Plan of fish trapping fence T1, Keogh River mainstem, showing 1977 layout with Wolf-type traps in overflow fence (Fisheries Research and Technical Services Section, Fish and Wildlife Branch, Vancouver, B. C.).

FIGURE 3. Fence T1 viewed from upstream at moderate level of flow, with protective logboom in foreground.

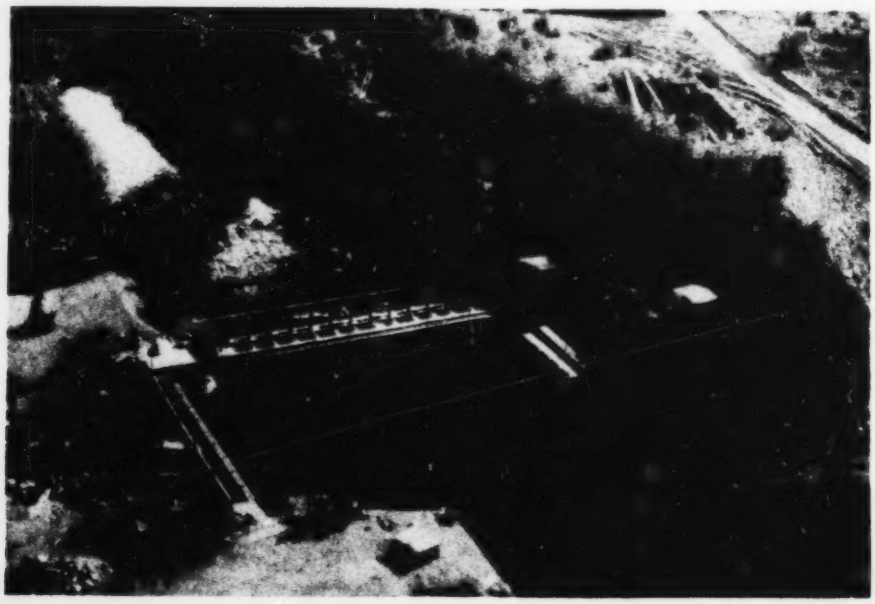

FIGURE 4. Aerial view of fence T1 in 1977, showing Wolf-type traps in overflow fence (left), and tagging shelter and holding boxes (right).

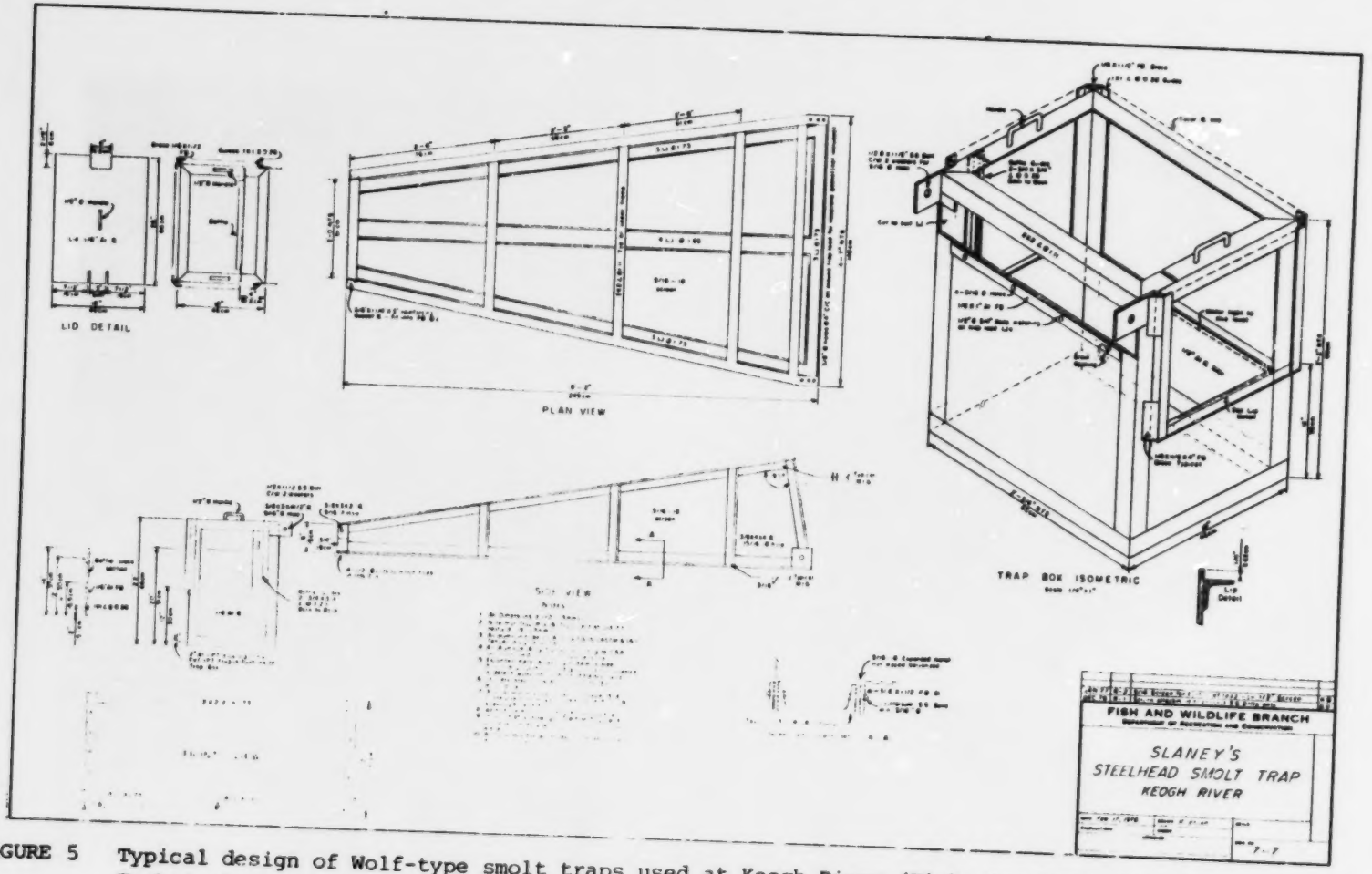

FIGURE 5 Typical design of Wolf-type smolt traps used at Keogh River (Fisheries Research and Technical Services Section, Fish and Wildlife Branch, Vancouver, B. C.).

FIGURE 6. Aerial view of fence T1 in 1978 showing modifications: stop-log fence across overflow channel (upper left), horizontal screen trap behind overflow fence, and centrally located tagging shelter.

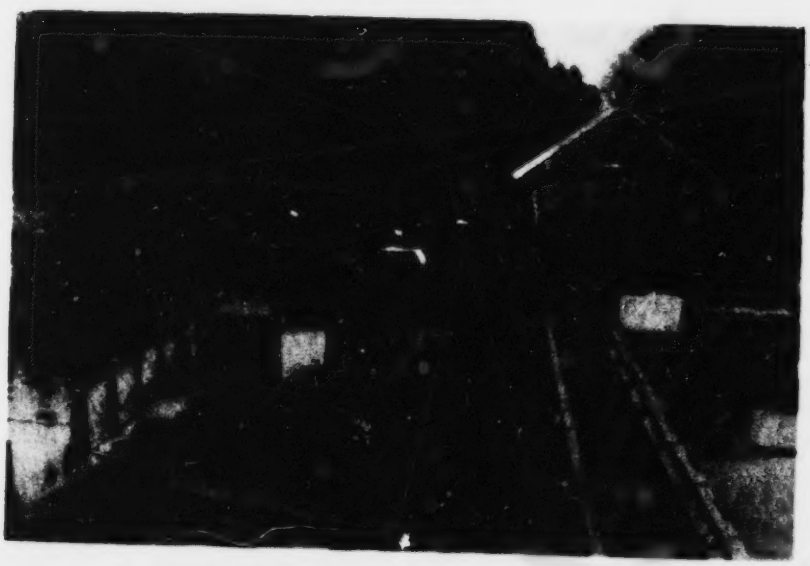

FIGURE 7. Overflow fence with horizontal screen trap at site T1, 1978. Stop-logs have been removed from stop-log fence to lower water level for installation of holding boxes.

Smolts were accumulated in the holding boxes until there were sufficient to warrant tagging. Periods of accumulation varied with the stage of the migration, ranging between one and nine days in 1977 and between one and eight days in 1978. Accumulation periods for 1977 and 1978 are listed in Appendices A and B respectively under the heading, "Maximum Holding Time".

TAGGING PROCEDURES

In applying coded-wire nosetags to coho smolts, the operation closely paralleled that described in Armstrong and Argue (1977). Smolts that did not activate the Quality Control Device (QCD) metal detector were automatically separated out for re-testing and, if necessary, re-tagging.

The total number of coho smolts tagged in 1977 was 42,263, of which 35,191 were released immediately after recovering from the anaesthetic. The remainder were detained for periods of one to seven days for use in checks of delayed mortality, tag loss, and the smolt catching efficiency of T1.

In 1978, 28,862 smolts were tagged. The immediate release portion was 27,161. Complete schedules of tagging and immediate release for the two years are presented in Appendices A and B.

Three tag codes were used in 1977, and two in 1978. The 1977 codes corresponded to the early, peak, and the late portions of the smolt migration, while the 1978 codes divided the migration into a pre-peak to early-peak portion and mid-peak to late portion.

ESTIMATION OF MORTALITY AND TAG LOSS

In order to determine rates of post-tagging mortality and of tag loss, samples of tagged fish were held overnight and, periodically, for as many as seven days. Also, immediate mortality was recorded for each tagging day as is shown in Appendices A and B. Additional tag loss information was provided by the recapture of tagged smolts which had been released upstream of fence T1 to measure its smolt efficiency.

To measure mortality and tag loss in 1977, 6977 (16.5%) of the tagged coho smolts were detained before release. About 35% (2451) of them were sampled twice - once after one day's detention, then again after further detention or upstream release and recovery. It is believed that sampling the smolts twice might have increased mortality due to stress.

In 1978, 807 (2.8%) of the smolts were detained for mortality and tag loss sampling. None were sampled twice or used for upstream release.

The sampling schedule for both years is shown in Appendix C.

Additional tag loss information from the recapture of upstream released smolts is tabulated in Appendix D. Recaptures provided a sample of 1980 fish in 1977, gathered over 15 sampling periods. In 1978, 12 sampling periods produced a total sample of 559.

TRAP EFFICIENCY TESTING

The efficiency of fence T1 in capturing smolts was tested to provide data for calculating total coho smolt production. Tagged and fin-clipped fish were released upstream of the fence, and the number of recaptures was recorded. Though trap efficiency testing was conducted in both 1977 and 1978, procedures varied considerably between the two years.

1977

In 1977, adipose-clipped, tagged fish to be released upstream were held overnight then anaesthetized again and tested for tag loss. Fish without tags were released downstream of the trap. For some of the upstream releases the smolts were given a second fin mark: either the upper or lower lobe of the caudal fin. Other groups were released with the adipose-only mark.

1978

Trap efficiency test results in 1977 were lower than expected, so several changes were made in the procedures for 1978. Smolts of approximately average size were selected non-randomly before tagging. Additional care was taken to ensure that no smolts showing any sign of injury were selected. Tagging procedures were altered to avoid double handling.

Before tagging, the multiple fin mark was applied. Tagging was undertaken with care to ensure maximum tag retention, and stress was minimized during recovery from the anaesthetic by maintaining smolts at low density with continuous circulation of fresh water. Samples were then released upstream into a still pool with good root mass and bank overhang cover.

The 1978 trap efficiency testing plan involved nine upstream releases of 200 smolts, with 3 releases in each of 3 run segments: early, middle, and late. The plan could not be entirely followed because the smolt output was smaller than expected. Instead, four releases were made in two segments (i) early to early-peak, and (ii) mid-peak to late.

Trap efficiency testing in 1978 did not use adipose-only fin marks. It was considered possible that a high rate of residualism might have occurred in upstream-released fish from 1977. The residualism could be measured in 1978 by watching for adipose-only marked, tagged fish because partial caudal clips were expected to have regenerated in the elapsed year. In addition,

avoiding the adipose-only mark in upstream releases might make it possible to count naturally missing adipose fins if it were possible to distinguish them from residual tagged fish which had shed the tag.

BIOLOGICAL SAMPLING

Scales, lengths (nose-fork), and weights were measured weekly from a random sample of smolts at fence T1. In 1977 the sampling period extended from April 27 to June 17, weekly sample size averaged about 100 and ranged from 77 to 125. In 1978 the sampling period extended from May 10 to June 15; weekly sample size averaged about 150 and ranged from 99 to 334. The sampling results at fence T1 are detailed in Appendices G - J.

Sampling results from fence T1 were used in calculating the weight of smolts tagged. The numbers of fish per pound and per kilogram were calculated for each tag code from the mean weights of smolts sampled during the time period in which the code was applied.

Biological sampling was also carried out at fences T2 to T5 by the Fish and Wildlife Branch. From 1977 sampling Fish and Wildlife provided length frequency information (Fisheries Research and Technical Services, unpublished). Fish and Wildlife 1978 data included length, weight and age sampling results.

OBSERVATIONS AND DISCUSSION

TAGGING RESULTS

Tagging of coho smolts is summarized for both years in Table 1.

TABLE 1. CWT codes applied to coho smolts, Keogh River, 1977 and 1978.

Year	Time Period of Capture	CWT Code (Agency 2)	Number Tagged	Number Released Immediately
1977	Apr.20 - May 11	1/5	9,725	8,451
	May 12 - May 27	12/5	24,538	21,865
	May 28 - June 21	2/5	8,000	4,875
1978	Apr.30 - May 13	20/33	9,662	8,989
	May 13 - June 21	20/27	19,200	18,172

For the 42,263 smolts tagged in 1977 and the 28,862 smolts tagged in 1978, adjustments can be made for mortality and tag loss.

Mortality

Short term delayed mortality is estimated to be 2.5% for 1977 and 1.3% for 1978. The 1977 estimate is arbitrarily lower than that calculated from mortality sampling results becasue 1977 mortality sampling is believed to have shown an artificially high mortality rate due to the practice of selecting the 2 to 7 day detention sample from fish already subjected to a one day detention sample. The detention itself was also a source of mortality in 1977, with fungus appearing on detained fish on more than one occasion.

Mortality sampling results are summarized in Table 2. It will be noticed that numbers of holding mortalities for 2 to 7 day detention samples in 1977 is an extrapolation because those samples were subsamples of one day detention samples. The 1977 mortality calculation omits one sample, May 20, due to high mortality from fungus.

TABLE 2. Delayed mortality of coded-wire tagged coho smolts held after tagging at Keogh River, 1977 and 1978.

Year	Number Sampled	No. of Tests	Holding Time (Days)	Holding Mortality		
				Number	Percent	
					Average	Range
1977	6245	10	1	61[a]	1.0	0.0 to 15.5
	2847	4	2 to 7	86[a]	3.0	0.5 to 15.5
1978	337	3	1	0	0.0	0.0
	470	2	3 to 6	6	1.3	0.8 to 1.5

[a] extrapolated from subsamples

Tag Loss

Short term (2 to 7 day) tag loss approximated 2.3% for both years. Tag loss sampling results are summarized in Table 3.

Additional information provided by recaptures of upstream released smolts suggests a 1977 tag loss of 4.1%, and a 1978 tag loss of 1.8% (Appendix D). The results gained from upstream release recoveries, however, are imprecise. Time out from tagging to recapture cannot be accurately assessed for either year; and for 1977 samples, in which the adipose-only mark was employed, the capture of smolts with naturally missing adipose fins could have inflated the tag loss measure by 40% or more. A ratio of naturally missing adipose fins such as that shown in 1978, 1:3400, would have pro-

duced a capture of approximately 12 naturally missing adipose fins in 1977. Furthermore, the 1978 ratio of naturally missing adipose fins in the Keogh was very low compared to the results of measurements in two other southern British Columbia rivers, in which the average ratio was approximately 1:1300 (Argue and Armstrong, 1977. Patterson et al., 1979).

TABLE 3. Tag loss of coded-wire tagged coho smolts held after tagging at Keogh River, 1977 and 1978.

Year	Number Sampled	No.of Tests	Detention Time (Days)	Tag Loss		
				Number	Percent	
					Average	Range
1977	6245	10	1	106[a]	1.7	0.0 to 3.3
	3264	5	2 to 7	75[a]	2.3	2.0 to 4.4
1978	337	3	1	3	0.9	0.0 to 1.6
	470	2	3 to 6	11	2.3	0.8 to 3.0

[a] extrapolated from subsamples

Corrected Total Tagged

Correcting total smolts tagged for short term mortality and short term tag loss gives release estimates of 40,235 in 1977 and 27,822 in 1978. Tag release calculations are shown in Table 4.

TABLE 4. Numbers of coho smolts tagged and released per CWT code, Keogh River, 1977 and 1978.

Year	Tag Code (Agency 2)	No. Tagged	Mortality		Tag Loss		Est. Release
			%	No.	%	No.[a]	
1977	1/5	9725	2.5	243	2.3	218	9264
	12/5	24538	2.5	613	2.3	550	23375
	2/5	8000	2.5	200	2.3	179	7621
1978	20/23	9662	1.3	126	2.3	219	9317
	20/27	19200	1.3	250	2.3	436	18514

[a] Calculated from "Number Tagged" minus "Mortality".

TRAP EFFICIENCY

The estimate of smolt production for each year is based on the gross number tagged and on the efficiency of fence T1. Trap efficiency must be calculated separately for each year because the structure of fence T1 changed, as did the testing methods.

1977

From the eight releases involving 3,653 smolts, 2,059 (56%) were recovered. Trap efficiency testing for 1977 is detailed in Appendix E and summarized in Table 5.

TABLE 5. Upstream releases, and recaptures of fin-marked coded-wire tagged coho smolts at fence T1, Keogh River, 1977.

Release Date	Number Released	Fin Mark	Percent Recaptured	Approx.% Recaptured Within 10 Days After Release
April 28	100	Adipose	59	16
May 6	100	Ad-Top Caudal		
12	692	Ad-Top Caudal	46	37
15	317	Ad-Top Caudal		
20	900	Ad-Bottom Caudal	70	64
27	754	Adipose		
June 2	560	Adipose	58	58

For the earliest release group, April 28, the low rate of recapture in the first 10 days after release may indicate that a high proportion were not fully smoltified at the time of initial capture, thus resulting in a lower than average rate of migration in the first 10 days after release.

A factor that appears to have had a small effect on the results of trap efficiency testing in 1977 is short term mortality. In 1977, mortality in the next few days after the one day mortality sample was 1.8% (Appendix C). Thus 1.8% may be considered a short term mortality correction factor and be subtracted from numbers released upstream.

A possible source of mortality that cannot be estimated may have affected the adipose-top caudal fin mark group in 1977. Two of its four releases, May 6 and May 15, were drawn from fish noted to be ".....badly scaled and stressed from excessive trap flow velocity" (Appendix A). The fish in both releases

had shown relatively high immediate mortality during tagging: 0.7% and 0.8% as compared to the average of 0.3%. Also, the fish of the May 6th release had experienced a 1-day holding mortality of 15.5% prior to being re-anaesthetized and given the caudal fin mark (Appendix C).

Because significant mortality is suspected but cannot be estimated for the adipose-top caudal group, the estimate of trap efficiency has been drawn only from the other two fin mark groups, adipose-only and adipose-bottom caudal. The resulting estimate of 1977 trap efficiency, corrected for short term mortality is therefore 64%. The calculations are summarized in Table 6.

TABLE 6. Estimate of smolt trapping efficiency of fence T1 at Keogh River in 1977, adjusted for suspected mortality.

Fin Mark	Release Dates	Number Released Upstream		Recaptures	
		Actual	Corrected for Short Term Mortality	Number	Percent
Adipose-Only	Apr. 28	100	98		
	May 27	754	740		
	June 2	560	550	821	59%
Ad.-Bottom Caudal	May 20	900	884	628	71%
		TOTAL	2272	1449	64%

Evidence in support of the above estimate of 1977 trap efficiency was provided in 1978 by the return of jacks to the O'Conner Lake fence. Of 122 jacks, 81 lacked the adipose fin, suggesting an incidence of tags of 66.4% (Slaney, pers. comm., 1979).

1978

Of the 1,200 smolts released in 1978, 559 (47%) were recovered. Also 10 smolts lacking only the adipose fin were captured. The Quality Control Device indicated the presence of a tag in only two of the 10 smolts, which suggests that residualism from 1977 was extremely low and that the incidence of naturally missing adipose fins among 1978 smolts was also very low, approximately 1:3400. It is considered unlikely that any of the 8 smolts that did not activate the QCD were actually tagged fish that had shed the tag. Since only 2 tagged residuals were recovered, the capture of one or more residual with tag loss would suggest a tag loss of 33% or greater - improbably high. Trap efficiency testing for 1978 is detailed in Appendix F and summarized in Table 7.

TABLE 7. Upstream releases, and recaptures of fin-marked, coded-wire tagged coho smolts at fence T1, Keogh River, 1978.

Release Date	Number Released	Fin Mark	Percent Recaptured
May 5	200	Ad-Top Caudal	
15	400	Ad-Top Caudal	53%
18	200	Ad-Bottom Caudal	
June 1	400	Ad-Bottom Caudal	40%

Short-term mortality (3 to 6 days) among tagged smolts in 1978 was 1.3% (Appendix C), which may be considered the short-term mortality correction factor and be subtracted from numbers released upstream.

A possible source of mortality that cannot be estimated may have affected the adipose-bottom caudal fin mark group in 1978 (Appendix B). The larger of its two releases, June 1, was drawn from fish that underwent stress due to anaesthetic temperatures as high as 19°C. Immediate mortality from tagging had been 0.7% as compared to the season average of 0.1%.

Because significant mortality is suspected for the adipose-bottom caudal group, the estimate of trap efficiency has been drawn only from the other fin mark group, adipose-top caudal. The resulting estimate of 1978 trap efficiency, corrected for short term mortality is 54%. The calculation is summarized in Table 8.

TABLE 8. Estimate of smolt trapping efficiency of fence T1 at Keogh River in 1978, adjusted for suspected mortality.

Fin Mark	Release Dates	Number Released Upstream		Recaptures	
		Actual	Corrected for Short term Mortality	Number	Percent
Adipose-Top Caudal	May 5	200	197		
	May 15	400	395		
		TOTAL	592	320	54%

SMOLT PRODUCTION

Based on trap efficiency of 64% for 1977, the estimate of smolt production for that year is 63,000 ± 4,000 at the 95% confidence level. The 1978 estimate of smolt production, based on 54% trap efficiency, is 52,000 ± 6,000.

MIGRATION TIMING

Peaks of coho smolt migration, as determined by the dates on which 50 percent of the total season captures at fence T1 were attained, were May 17 in 1977 and May 16 in 1978.

In 1977 the peak 50 percent of migration occurred in the period, May 11 to 24. In 1978 the peak 50 percent of migration occurred during May 8 to 27.

Daily captures of coho smolts at fence T1 are shown in Figure 8 for both years.

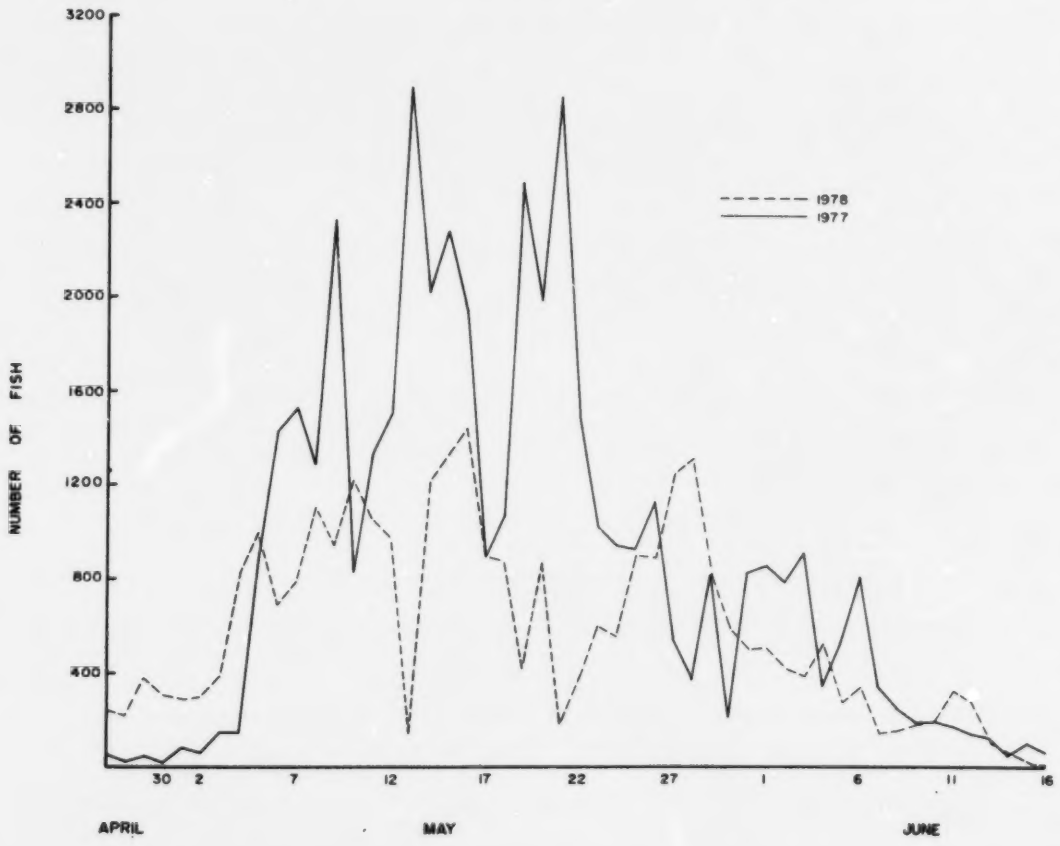

FIGURE 8. Daily captures of coho juveniles at fence T1, Keogh River, 1977 and 1978.

SIZE AND AGE OF MIGRANTS

Fence T1

Age composition of coho smolts in 1977 was 90% age 1. and 10% age 2.. In 1978 it was similar:93% and 7%. In both years the percentage of age 2. smolts was greater than 10% in samples taken on or before May 11, and less than or equal to 10% thereafter. In neither year however was there a consistent seasonal trend in age composition - possibly the result of varying migration timing among tributary populations.

Mean length in 1977 was 103mm, and in 1978, 102mm. Length frequencies graphed in Figures 9 and 10, and mean length at age is summarized in Table 9. In neither year was there a consistent season trend in length - again, possibly the result of varying migration timing among tributary populations.

TABLE 9. Length at age of coho smolts at fence T1, Keogh River, 1977 and 1978.

1977	Age 1.	Age 2.	Total
Mean (mm)	100.3	120.7	103.4
Std. Dev.	16.1	16.3	17.5
Std. Error	0.6	2.0	0.6
1978			
Mean	100.5	127.7	102.4
Std. Dev.	18.7	23.1	19.8
Std. Error	0.7	3.0	0.7

Mean weight in both years was 12g. Weight at age is summarized in Table 10.

TABLE 10. Weight at age of coho smolts at fence T1, Keogh River, 1977 and 1978.

1977	Age 1.	Age 2.	Total
Mean (g)	11.1	18.7	12.4
Std. Dev.	6.0	7.9	6.8
Std. Error	0.2	1.0	0.2
1978			
Mean	11.3	21.3	12.0
Std. Dev.	7.8	12.8	8.5
Std. Error	0.3	0.3	1.7

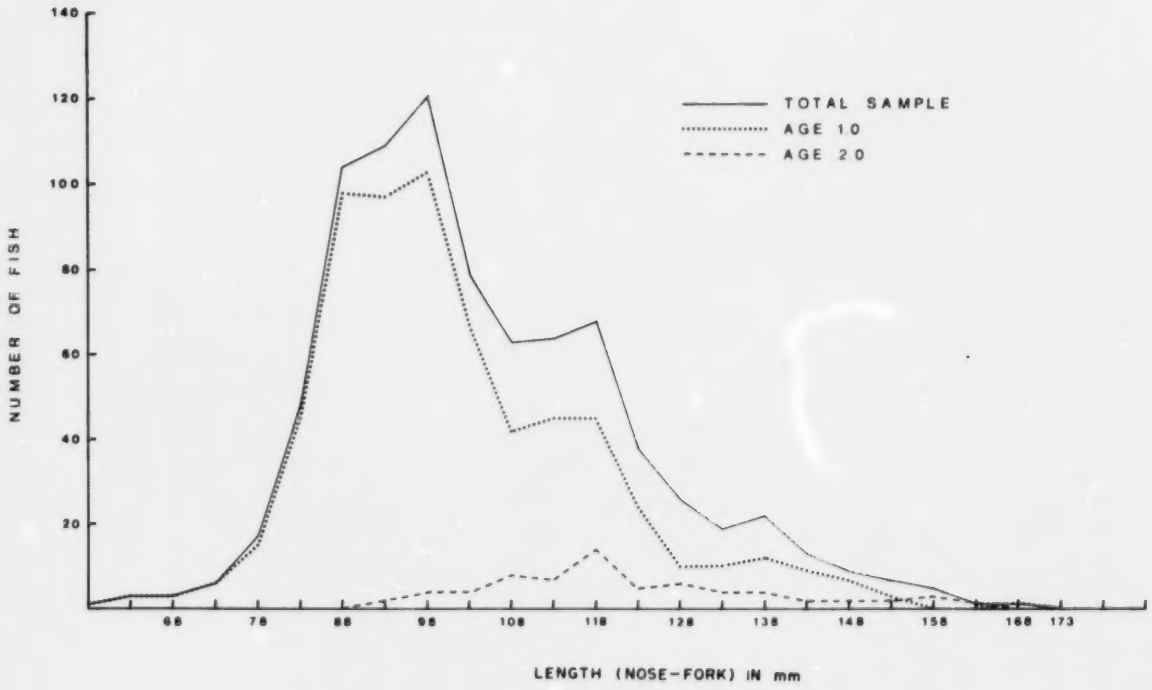

FIGURE 9. Length frequency distribution of coho smolts at fence T1, Keogh River, 1977.

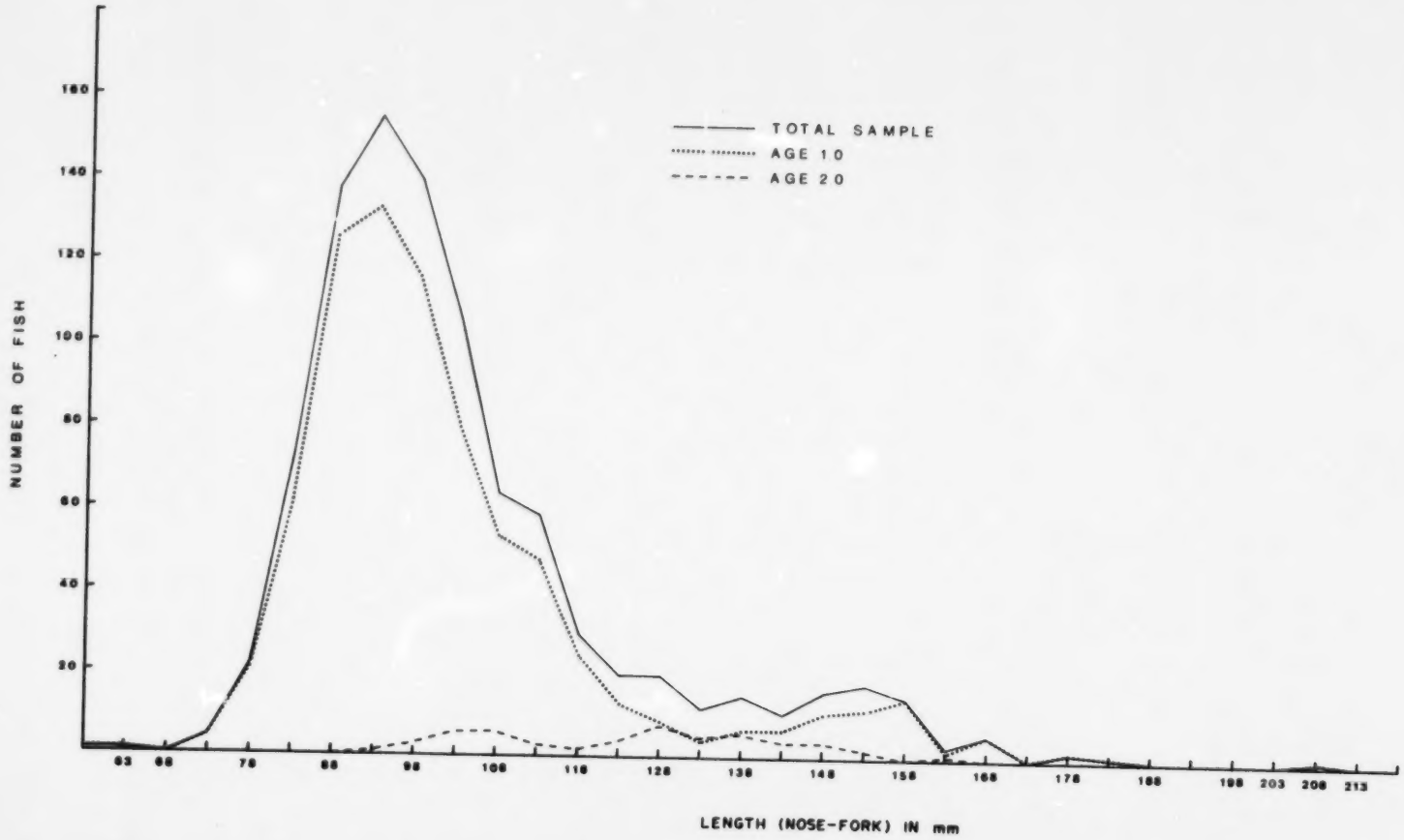

FIGURE 10. Length frequency distribution of coho smolts at fence T1, Keogh River, 1978.

Weight of smolts tagged, calculated from fence T1 sampling data is presented in Table 11.

TABLE 11. Number of coho smolts per pound (and per kilogram) by tag code, Keogh River, 1977 and 1978.

Year	Tag Code (Agency 2)	Application Period	Smolts/ Pound	Smolts/ Kg
1977	1/5	Apr. 27 to May 11	26.62	58.69
	12/5	May 12 to May 27	39.58	87.26
	2/5	May 31 to June 27	48.24	106.35
1978	20/33	May 4 to May 16	37.88	83.51
	20/27	May 16 to June 21	37.37	82.39

Tributary Fences

For 1977, only unaged length information is available from the Fish and Wildlife Branch for fences T2 and T5. O'Conner Lake, fence T5, smolts were outstandingly large: 139 mm mean length. Smolts of the other three tributary traps appear closely grouped in mean length in the 85 to 100 mm range. Length frequencies in May for the four tributary fences are graphed in Figure 11.

For 1978, aged length and weight information is available. Sampling was conducted at all fences except Misty Lake (T4) during the third week in May. The pattern of comparative length during that week was similar to that of 1977, with O'Conner Lake smolts showing a mean length 40 mm greater than that at Fence T1. A high percentage of age 1 in the O'Conner Lake sample indicates that the larger mean size is a product of large size at age, not of greater mean age. Table 12 summarizes tributary fence sampling results for the third week in May. The total season sampling results are summarized in Appendix L.

TABLE 12. Age and size of coho juveniles at tributary fence traps on Keogh River system, May 15 - 21, 1978.

	Keogh River T1	Muir Lake T2	West Trib. T3	O'Conner Lake T4
Percent Age 1	93	87	81	96
Sample Size	164	15	21	15
Mean Length (mm)	104	109	99	144
Mean Weight (g)	13	14	13	35
Sample Size	200	25	25	25

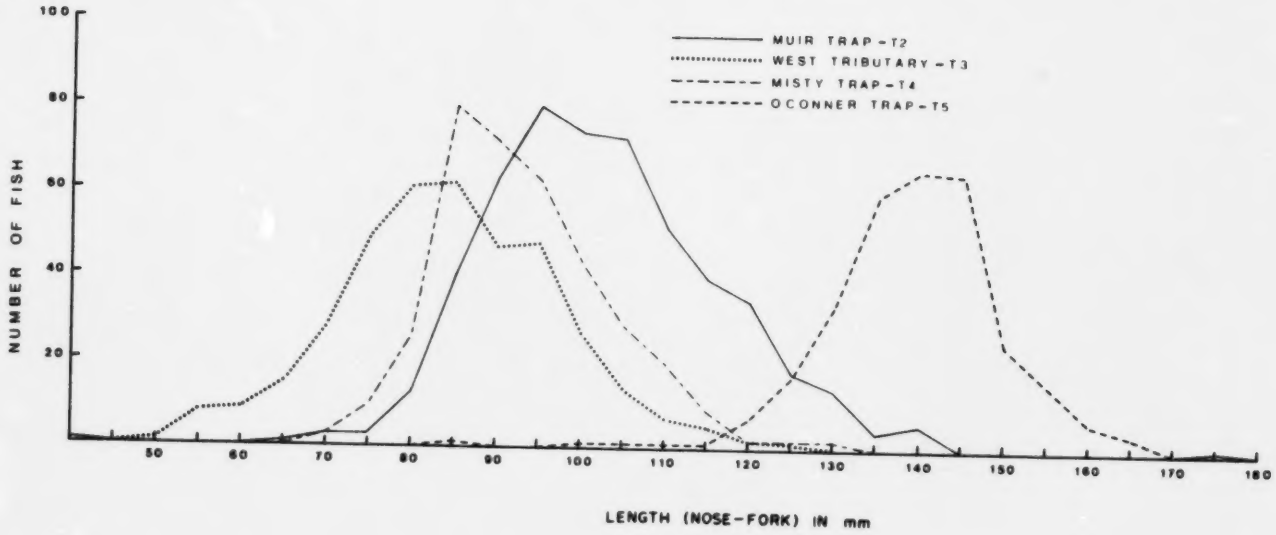

FIGURE 11. Length frequency distributions of coho smolts at fences on four tributaries of the Keogh River, May 1977 (Fisheries Research and Technical Services Section, Fish and Wildlife Branch, Vancouver, B. C., unpublished).

SUMMARY

1. Correcting for short term tag loss and for post-tagging mortality gives tagged coho smolt release estimates of 40,235 for 1977, and 27,822 for 1978.

2. The estimates of coho smolt production at the 95% confidence level are 63,000 ± 4,000 for 1977, and 52,000 ± 6,000 for 1978.

3. In both years the weeks of most active coho smolt migration were the second, third and fourth weeks of May. Peak migration occurred in the third week of May.

4. The incidence of age 2. in the coho smolt migration appears to be 7 to 10 percent, with the proportion of age 2. at its highest during the first 35% of the migration.

5. Yearly mean length of coho smolts was in the range, 102 to 103mm. Yearly mean weight was in the range, 12 to 12.4 g.

6. Samples from four tributaries of the Keogh River indicate that smolt size varies significantly among the tributaries. In both years of sampling, the mean length of smolts from O'Conner Lake fence was more than 35 mm greater than at Keogh River Fence T1.

7. The incidence of naturally missing adipose fins among coho smolts in 1978 was 1:3400.

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APPENDICES

APPENDIX A. SCHEDULE OF COHO SMOLT TAGGING AT KEOGH RIVER, 1977.

Tagging Date - 1977	Maximum Holding Time (Days)	Tagging Time (Hours)	H_2O Temp. (°C)	Tag Data Code (Agency 2)	Immediate (Handling) Mortality	Total Number Tagged	Released Downstream Immediately	Held for Tag Loss Check & Upstream Release	Remarks
April 27	8	3	-	1/5	0	351	156	195	
May 5	7	2	10	1/5	7	956	756	200	Fish badly scaled & stressed from excessive trap flow velocity.
10	4	2½	10	1/5	0	1424	1253	171	
11	6	8	9	1/5	0	6994	6286	708	
12	1	2	9	12/5	5	2391	2050	341	
14	2	5½	9	12/5	27	3453	3036	417	Fish badly scaled & stressed from excessive trap flow velocity.
17	3	2½	11-13	12/5	68	2318	2318	0	Fish stressed from May 14 freshet then overcrowded in holding bucket.
18	3	5-3/4	11-14	12/5	9	3040	3040	0	
19	3	6	12	12/5	5	3498	2449	1049	
25	4	5	11	12/5	10	3307	3307	0	
26	5	6½	9	12/5	5	5381	4515	886	
27	6	2	10	12/5	0	1150	1150	0	
31	5	3	11	2/5	0	2235	1514	721	
June 3	3	2½	10	2/5	0	1748	1748	0	
9	6	3½	13	2/5	8	3052	1507	1545	
17	7	1½	14.5	2/5	3	859	0	859	
27	9	¼	13	2/5	0	106	106	0	
TOTALS						42,263	35,191		

APPENDIX B. SCHEDULE OF COHO SMOLT TAGGING AT KEOGH RIVER, 1978.

Tagging Date 1978	Maximum Holding Time (days)	Tagging Time (hours)	Water Temp. (°C)	Tag Data Code (Agency 2)	Immediate (handling) Mortality	Total Tagged	Released Downstream Immediately	Held For Tag Loss Check and/or Released Upstream	Remarks
May 4	5	1¼	8 - 9	20/33	0	1689	1522	167	
5	2	-	9 - 10	20/33	0	1813	1443	370	
11	6	-	12	20/33	0	881	756	125	
12	6	-	9 - 10	20/33	1	2828	2817	11	
15	5	2½	13	20/33	2	1091	1091	-	
16	6	2	11	20/33	0	1360	1360	-	
16	3	4½	11	20/27	1	2675	2575	100	
17	4	-	11	20/27	0	1979	1979	-	
18	1	-	12	20/27	0	1603	1403	200	
26	8	5½	11 - 12	20/27	0	4855	4755	100	
June 1	6	4¼	14 - 19*	20/27	30	4070	3590	480	
2	4	1½	13 - 15	20/27	1	1039	991	48	*19° indicates anaesthetic temp. - che river was 17° at this time
7	4	3½	19	20/27	-	1644	1544	100	
15	8	2½	13	20/27	0	1260	1260	-	
21	5	-	15	20/27	0	75	75	-	
TOTALS						28,862	27,161		

APPENDIX C. TAG LOSS AND DELAYED MORTALITY SAMPLING OF CODED-WIRE TAGGED COHO SMOLTS AT KEOGH RIVER, 1977 and 1978.

Year	Sample Held Until		Number Sampled	Duration Holding (Days)	Tag Losses	Holding Mortalities	Handling Mortalities
1977	April	28	195	1	1	3	0
	May	6	200	1	2	31	0
		10	91	4	1	0	0
		11	176	1	3	5	0
		12	708	1	7	4	8
		13	230	1	0	7	4
		15	417	1	10	0	1
		20	1049	1	15	0	0
		20	100	6	0	6	0
		27	866	1	29	1	0
		27	187	7	1	1	0
	June	2	732	2	19	11	0
		2	93	6	1	4	0
		10	1545	1	22	7	0
		18	859	1	17	3	0
TOTAL			7448		128	83	13
1978	May	2	337	6	10	5[a]	
		15	133	3	1	1	
		17	188	1	3	0	
		27	98	1	0	0	
	June	2	51	1	0	0	
TOTAL			807		14	6	

a "Holding Mortalities" and "Handling Mortalities" not separated in 1978.

APPENDIX D. TAG LOSS IN COHO SMOLTS RECAPTURED AFTER RELEASE UPSTREAM OF FENCE T1 AT KEOGH RIVER, 1977 and 1978.

Year	Sampling Date		Number Recaptured	Number without Tags
1977	May	5	14	3
		6	5	3
		10	11	0
		11	32	5
		12	7	1
		14	191	0
		17	120	2
		18	116	2
		19	46	2
		25	165	1
		26	385	3
		27	83	0
		31	336	6
	June	3	323	10
		9	146	5
TOTAL			1980	43
1978	May	11	71	1
		12	51	4
		15	5	0
		16	14	1
		17	125	1
		18	30	0
		26	53	0
	June	1	25	2
		2	75	0
		7	63	0
		15	46	1
		21	1	0
TOTAL			559	10

APPENDIX E. SCHEDULE OF TRAP EFFICIENCY TESTING, FENCE T1, KEOGH RIVER, 1977.

Date 1977	Number Released Upstream			Cum. Total Available	No. Recaptured at T1				
	Ad. Only	Ad/Caudal	Cum.Total		Ad.only	Ad/Top Caudal	Ad/Bottom Caudal	Cum.Total	% of Cum. Total Released
April 28	100	-	100	-	-	-	-	-	-
May 5	-	-	-	100	16	-	-	16	16 %
6	-	100	200	84	-	-	-	-	-
10	-	-	-	184	1	10	-	27	-
11	-	-	-	173	12	20	-	59	29.5
12	-	692	892	141	3	4	-	66	-
13	-	230	1122	826	-	-	-	-	-
14	-	-	-	1056	1	190	-	257	-
15	-	317	1439	865	-	-	-	-	-
17	-	-	-	1182	7	113	-	337	-
18	-	-	-	1062	4	112	-	493	-
19	-	-	-	946	1	45	-	539	37.5
20	-	900	2339	900	3	3	-	545	-
25	-	-	-	1794	5	21	139	710	-
26	-	-	-	1629	3	51	336	1100	-
27	754	-	3093	1239	3	13	62	1178	-
31	-	-	-	1915	284	15	37	1514	-
June 2	560	-	3653	1579	5	-	2	1521	-
3	-	-	-	2132	285	9	29	1814	50.5
5	-	-	-	1809	59	3	9	1915	-
9	-	-	-	1738	124	1	14	2054	56.2
27	-	-	-	1599	5	-	-	2059	56.4

Top Caudal

Bottom Caudal

APPENDIX F. SCHEDULE OF TRAP EFFICIENCY TESTING, FENCE T1, KEOGH RIVER, 1978.

Date 1978	Number Released			Cumulative Total Available	Number Recovered			% of Cumulative Total Released Recovered
	Group #1 Ad/Top Caudal	Group #2 Ad/Bottom Caudal	Cumulative Total Released		Group #1	Group #2	Cumulative Total Recovered	
May 5	200	-	200	-	-	-	-	-
6-7	-	-	-	200	71	-	71	-
7-10	-	-	-	129	51	-	122	-
10-12	-	-	-	78	5	-	127	-
13	-	-	-	73	7	-	134	-
14	-	-	-	66	7	-	141	-
15	400	-	600	59	3	-	144	70.5
16	-	-	-	456	125	-	269	-
17	-	-	-	331	23	-	292	-
18	-	200	800	508	-	-	-	48.7
19	-	-	-	493	7	8	307	-
20	-	-	-	473	-	20	327	-
21	-	-	-	461	7	5	339	-
26	-	-	-	452	-	9	348	-
27	-	-	-	434	8	10	366	-
28	-	-	-	431	-	3	369	-
31	-	-	-	423	6	2	377	-
June 1	-	400	1200	823	-	-	-	47.1
2	-	-	-	-	-	72	449	-
3	-	-	-	751	-	27	476	-
4	-	-	-	724	-	14	490	-
5	-	-	-	710	-	5	495	-
7	-	-	-	705	-	17	512	-
9	-	-	-	688	-	6	518	-
10	-	-	-	682	-	8	526	-
11	-	-	-	674	-	16	542	-
12	-	-	-	658	-	12	554	-
21	-	-	-	646	-	5	559	-
				641				46.6

APPENDIX G. COHO SMOLT LENGTH FREQUENCY BY AGE AND SAMPLING DATE, KEOGH RIVER, 1977.

Sampling Lot	#1 April 27			#2 May 5			#3 May 10			#4 May 14			#5 May 25			#6 May 31			#7 June 9			#8 June 17			Combined Total		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Fork Length (mm)																											
55.0 - 59.9	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
60.0 - 64.9	2	2	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0
65.0 - 69.9	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0
70.0 - 74.9	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0
75.0 - 79.9	4	4	0	2	1	0	0	0	0	1	0	0	1	1	0	1	1	0	2	2	0	0	0	0	17	15	0
80.0 - 84.9	5	4	0	0	0	0	0	0	0	5	5	0	2	2	0	3	3	0	4	4	0	1	1	0	48	45	0
85.0 - 89.9	2	1	0	4	4	0	3	3	0	11	7	0	6	6	0	8	8	0	19	19	0	5	5	0	104	98	0
90.0 - 94.9	1	1	0	2	2	0	8	6	0	16	10	0	16	15	0	11	11	0	25	25	0	12	12	0	109	97	2
95.0 - 99.9	2	1	0	3	0	1	13	10	1	7	5	0	11	10	1	21	16	1	30	30	0	22	20	0	121	103	4
100.0 - 104.9	7	3	1	8	7	1	9	7	0	15	13	1	17	13	1	11	7	1	23	22	0	25	25	0	79	67	4
105.0 - 109.9	8	2	2	12	10	1	11	5	2	7	6	0	12	11	0	8	7	0	8	8	0	12	11	1	63	42	8
110.0 - 114.9	10	6	2	9	7	0	14	8	1	13	10	1	11	6	1	9	8	0	2	2	0	3	3	0	64	45	7
115.0 - 119.9	13	6	3	14	8	4	15	11	1	12	11	1	8	7	0	3	2	1	4	3	1	3	2	1	68	45	14
120.0 - 124.9	6	3	0	8	6	1	11	7	0	6	6	0	5	4	1	6	1	3	1	1	0	4	3	1	38	26	5
125.0 - 129.9	1	0	1	7	4	1	9	3	0	3	0	2	1	0	0	3	0	3	3	2	1	0	0	0	26	10	6
130.0 - 134.9	2	1	0	5	3	0	3	0	1	2	2	0	0	0	0	0	0	0	2	1	1	4	2	1	19	10	4
135.0 - 139.9	1	1	0	10	6	0	2	1	1	2	1	1	3	1	2	1	1	0	1	0	1	2	2	0	22	12	4
140.0 - 144.9	3	2	0	6	4	1	1	1	0	1	0	1	3	2	0	0	0	0	0	0	0	4	1	2	13	9	2
145.0 - 149.9	2	1	1	1	2	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	9	7	2
150.0 - 154.9	1	0	0	2	1	0	0	0	0	0	0	0	2	2	0	0	0	0	1	1	0	0	0	0	7	3	2
155.0 - 159.9	0	0	0	4	0	2	1	0	1	0	0	0	1	1	1	1	0	1	0	0	0	1	1	0	5	0	3
160.0 - 164.9	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
165.0 - 169.9	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
SAMPLE SIZE	77	45	10	100	65	14	100	62	8	100	75	7	79	61	9	125	108	10	125	120	4	100	90	7	827	646	68
MEAN	106.58	101.29	116.40	119.63	116.62	127.07	111.07	108.26	120.75	101.70	103.92	123.14	101.70	99.52	116.11	95.78	93.76	117.00	93.16	92.60	122.00	100.70	98.77	121.83	103.43	100.30	120.46
STD. DEV.	22.60	25.67	12.30	18.37	16.53	21.14	13.22	12.34	18.35	14.92	13.80	14.69	16.44	15.75	17.89	12.13	10.11	15.63	11.78	10.71	7.26	15.68	14.20	16.18	17.46	16.06	16.34
STD. ERROR	2.58	3.83	3.89	1.84	2.05	5.65	1.32	1.57	6.48	1.68	1.59	5.55	1.84	1.75	5.96	1.08	0.97	4.94	1.05	0.98	3.63	1.57	1.50	5.79	0.61	0.63	1.98

APPENDIX H. COHO SMOLT WEIGHT FREQUENCY BY AGE AND SAMPLING DATE, KEOGH RIVER, 1977.

Sampling Lot	#1 April 27			#2 May 5			#3 May 10			#4 May 14			#5 May 25			#6 May 31			#7 June 9			#8 June 17			Combined Total		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Weight (gm)																											
2.0 - 3.9	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0
4.0 - 5.9	4	4	0	1	0	0	0	0	0	6	4	0	9	9	0	9	9	0	20	20	0	3	3	0	52	49	0
6.0 - 7.9	3	2	0	7	7	0	6	5	0	18	10	0	26	26	0	49	48	0	53	52	0	28	27	0	190	177	0
8.0 - 9.9	5	5	0	1	0	0	16	12	1	14	11	1	22	15	2	11	26	2	26	26	0	33	33	1	150	128	7
10.0 - 11.9	5	3	0	10	8	1	12	10	0	19	17	0	14	12	1	22	19	0	14	14	0	13	13	0	109	96	2
12.0 - 13.9	6	4	2	14	10	2	17	8	1	11	8	1	13	10	2	3	3	0	3	2	1	6	3	1	74	48	12
14.0 - 15.9	5	0	2	11	7	3	16	9	1	14	13	0	5	1	0	4	1	3	2	2	0	3	3	0	60	38	9
16.0 - 17.9	9	5	1	9	5	2	10	7	0	5	4	1	0	0	0	3	0	3	1	1	0	1	0	1	38	21	9
18.0 - 19.9	6	1	2	6	5	0	11	7	0	4	4	0	1	1	0	1	0	1	1	1	0	2	1	1	36	20	6
20.0 - 21.9	12	9	0	9	7	1	4	2	1	4	1	2	3	1	2	1	1	0	1	1	0	3	2	1	37	22	5
22.0 - 23.9	2	0	1	2	2	0	4	2	1	1	1	0	1	1	0	0	0	0	1	0	1	3	2	1	14	8	4
24.0 - 25.9	0	0	0	9	4	1	2	1	1	1	1	0	2	1	1	1	0	1	0	0	0	2	0	1	15	7	3
26.0 - 27.9	1	0	1	8	4	1	0	0	0	2	1	1	2	1	1	0	0	0	1	1	0	7	2	0	16	9	3
28.0 - 29.9	5	4	0	4	3	0	1	1	0	2	1	1	0	0	0	1	1	0	1	1	0	1	1	0	15	11	2
30.0 - 31.9	1	1	0	2	1	1	0	0	0	1	0	1	2	1	1	0	0	0	0	0	0	1	1	0	1	2	1
32.0 - 33.9	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1
34.0 - 35.9	2	0	1	2	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	2	1
36.0 - 37.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
38.0 - 39.9	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
40.0 - 41.9	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42.0 - 43.9	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44.0 - 45.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46.0 - 47.9	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48.0 - 49.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
50.0 - 51.9	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAMPLE SIZE	77	45	10	100	65	14	100	62	8	100	75	7	100	81	9	125	108	10	125	120	4	100	90	6	827	646	68
MEAN	17.08	15.68	19.67	10.89	17.35	21.56	14.44	13.52	18.89	12.04	12.03	19.19	10.88	10.10	15.97	9.25	8.58	16.22	8.69	8.18	18.15	10.74	10.06	18.10	12.37	11.15	18.69
STD. DEV.	9.30	10.38	6.86	8.32	7.09	10.60	5.29	4.78	9.60	5.17	4.01	7.09	5.80	5.30	7.01	3.93	2.69	7.25	3.80	3.17	3.91	5.29	4.64	6.17	6.84	6.00	7.91
STD. ERROR	1.06	1.55	2.17	0.83	0.88	2.83	0.53	0.61	3.39	0.52	0.93	2.68	0.58	0.60	2.34	0.35	0.28	2.29	0.34	0.31	1.96	0.53	0.49	2.52	0.24	0.24	0.96

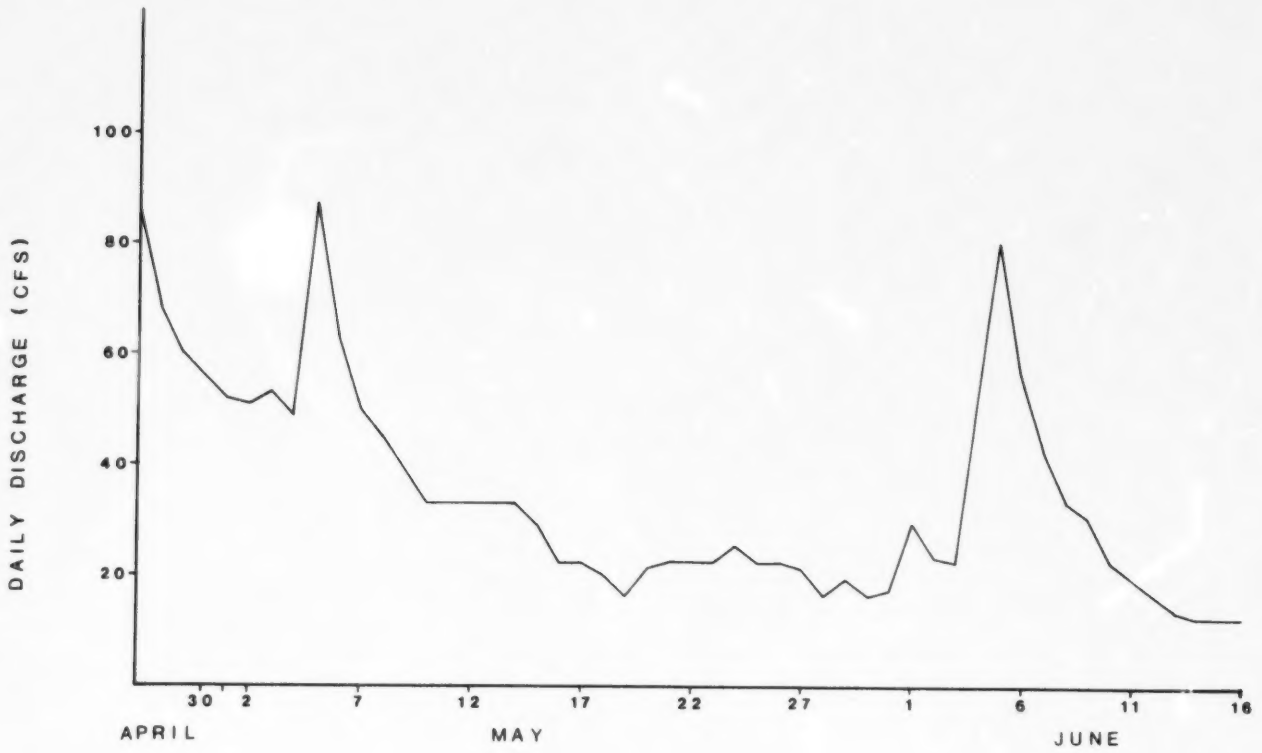
APPENDIX I. COHO SMOLT LENGTH FREQUENCY BY AGE AND SAMPLING DATE, KEOGH RIVER, 1978.

Sampling Lot	May 10 & 11			May 15 & 17			May 29			June 2			June 8			June 16			Combined Totals		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Fork Length (mm)																					
55.0 - 59.9	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
60.0 - 64.9	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
65.0 - 69.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.0 - 74.9	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75.0 - 79.9	1	1	0	3	3	0	1	1	0	2	2	0	4	3	0	3	3	0	5	5	0
80.0 - 84.9	18	16	0	10	9	0	6	5	0	11	9	0	5	5	0	22	18	0	72	62	0
85.0 - 89.9	38	37	0	23	20	0	8	8	0	14	13	0	20	17	0	35	31	0	138	126	0
90.0 - 94.9	39	32	1	27	22	0	24	21	0	30	29	0	28	21	0	7	7	0	155	132	1
95.0 - 99.9	55	45	2	39	30	0	17	17	0	9	9	0	11	9	0	9	6	1	140	116	3
100.0 - 104.9	53	42	4	29	20	1	12	11	1	6	4	0	4	3	0	2	1	0	106	81	6
105.0 - 109.9	38	33	4	14	11	1	4	3	1	5	5	0	3	2	0	0	0	0	64	54	6
110.0 - 114.9	28	21	2	17	14	1	3	3	0	8	7	0	2	2	0	1	1	0	59	48	3
115.0 - 119.9	20	16	2	6	5	0	1	1	0	2	2	0	1	1	0	0	0	0	30	25	2
120.0 - 124.9	9	4	3	6	4	1	2	2	0	2	2	0	0	0	0	1	1	0	20	13	4
125.0 - 129.9	12	2	7	3	3	0	2	2	0	3	2	1	0	0	0	0	0	0	20	9	8
130.0 - 134.9	6	2	2	5	2	2	0	0	0	0	0	0	1	0	1	0	0	0	12	4	5
135.0 - 139.9	5	1	4	3	1	1	3	3	0	1	1	0	3	1	1	0	0	0	15	7	6
140.0 - 144.9	4	3	1	2	0	2	4	3	1	1	1	0	0	0	0	0	0	0	11	7	4
145.0 - 149.9	3	0	3	5	3	1	1	1	0	2	2	0	4	4	0	1	1	0	16	11	4
150.0 - 154.9	0	0	0	3	2	0	8	6	1	0	0	0	6	4	1	1	0	0	18	12	2
155.0 - 159.9	0	0	0	4	4	0	2	2	0	2	2	0	5	5	0	2	2	0	15	15	0
160.0 - 164.9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	2	0	3	2	1
165.0 - 169.9	0	0	0	0	0	0	0	0	0	2	2	0	2	2	0	2	2	0	6	6	0
170.0 - 174.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175.0 - 179.9	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	2	0	2
180.0 - 184.9	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
185.0 - 189.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
190.0 - 194.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
195.0 - 199.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200.0 - 204.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
205.0 - 209.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1
SAMPLE SIZE	334	259	36	200	153	11	99	89	5	100	92	1	100	79	4	100	86	2	933	758	59
MEAN	102.54	99.51	122.06	104.26	102.35	131.55	106.44	105.01	136.40	100.34	100.51	129.00	105.13	104.43	146.00	93.39	92.05	150.00	102.38	100.52	127.73
STD. DEV.	15.04	12.53	18.19	18.42	17.25	21.83	23.01	21.34	31.01	19.24	19.54	0.0	26.10	26.22	15.25	23.86	21.48	77.78	19.84	18.65	23.11
STD. ERROR	0.82	0.78	3.03	1.30	1.39	6.58	2.31	2.26	13.87	1.92	2.04	0.0	2.61	2.95	7.63	2.39	2.32	55.00	0.65	0.68	3.01

APPENDIX J. COHO SMOLT WEIGHT FREQUENCY BY AGE AND SAMPLING DATE, KEOGH RIVER, 1978.

Sampling Lot	May 10 & 11			MAY 15 & 17			May 29			June 2			June 8			June 15					
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Weight (gm)																					
2.0 - 3.9	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
4.0 - 5.9	13	11	0	8	8	0	5	4	0	8	8	0	16	14	0	29	26	0	79	69	0
6.0 - 7.9	61	56	1	36	35	0	31	28	0	36	35	0	46	36	0	46	41	0	256	229	1
8.0 - 9.9	85	69	4	51	37	1	19	19	0	24	22	0	11	9	0	13	10	1	203	166	6
10.0 - 11.9	62	53	3	34	24	0	15	14	1	10	8	0	1	1	0	1	0	0	123	100	4
12.0 - 13.9	42	35	4	25	19	1	4	3	1	4	4	0	1	0	0	1	1	0	77	62	6
14.0 - 15.9	24	17	3	11	10	1	3	3	0	6	6	0	2	2	0	0	0	0	46	38	4
16.0 - 17.9	15	8	5	7	5	1	2	2	0	1	1	0	0	0	0	1	1	0	26	17	6
18.0 - 19.9	7	1	3	2	2	0	1	1	0	2	1	1	0	0	0	1	1	0	12	5	4
20.0 - 21.9	10	2	5	5	3	1	1	1	0	1	1	0	0	0	0	0	0	0	17	7	6
22.0 - 23.9	6	3	3	4	1	3	1	1	0	0	0	0	2	1	1	0	0	0	13	6	7
24.0 - 25.9	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	3	2	1
26.0 - 27.9	2	2	0	2	1	0	2	1	1	1	1	0	1	0	0	0	0	0	8	5	1
28.0 - 29.9	0	0	0	1	1	0	0	0	0	2	2	0	0	0	0	0	0	0	3	3	0
30.0 - 31.9	4	0	4	2	1	0	3	3	0	1	1	0	1	1	0	1	1	0	12	7	4
32.0 - 33.9	0	0	0	4	2	1	5	4	0	1	1	0	3	2	1	0	0	0	13	9	2
34.0 - 35.9	0	0	0	0	0	0	2	2	0	1	1	0	3	3	0	2	1	0	8	7	0
36.0 - 37.9	0	0	0	3	3	0	2	2	0	0	0	0	4	2	1	1	1	0	10	8	1
38.0 - 39.9	0	0	0	1	1	0	1	0	1	0	0	0	3	1	0	2	2	0	7	6	1
40.0 - 41.9	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2	0
42.0 - 43.9	0	0	0	1	1	0	0	0	0	1	1	0	1	0	1	0	0	0	3	2	1
44.0 - 45.9	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	1	0	3	3	0
46.0 - 47.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
48.0 - 49.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50.0 - 51.9	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1
52.0 - 53.9	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0
54.0 - 55.9	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	1	1
56.0 - 57.9	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
58.0 - 59.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
60.0 - 61.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62.0 - 63.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64.0 - 65.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66.0 - 67.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0 - 69.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAMPLE SIZE	334	259	36	200	153	11	99	89	5	100	92	1	100	79	4	100	86	2	933	758	59
MEAN	11.39	10.34	18.41	12.56	11.82	23.35	13.56	12.79	26.38	11.13	11.25	18.40	13.92	13.72	33.85	9.94	9.34	38.75	11.96	11.28	21.91
STD. DEV.	5.23	3.70	8.88	7.78	7.15	12.68	9.99	8.82	17.52	8.04	8.29	0.0	13.01	13.16	9.12	10.67	9.07	43.20	8.46	7.81	12.82
STD. ERROR	0.29	0.23	1.48	0.55	0.55	3.82	1.00	0.93	7.84	0.80	0.86	0.0	1.30	1.48	4.56	1.07	0.98	30.55	0.28	0.28	1.67

APPENDIX K. DAILY DISCHARGE OF THE KEOGH RIVER, APRIL 27 to JUNE 16, 1978: MEASURED AT PUMPHOUSE, 2.4 KM FROM MOUTH.



APPENDIX L. SUMMARY OF AGE AND SIZE OF COHO JUVENILES AT TRIBUTARY FENCE TRAPS, KEOGH RIVER SYSTEM, MAY 8 to JUNE 11, 1978.

	Muir Lake T2	West Trib. T3	Misty Lake T4	O'Conner Lake T5
Mean Length (mm)	102.46	98.64	99.26	148.58
Std. Dev.	8.26	11.24	6.33	15.28
Std. Error	0.75	1.22	1.22	2.16
Sample Size	120	85	27	50
at Age 1	101.92	98.18	-	146.72
Std. Dev.	7.84	8.84	-	13.17
Std. Error	1.08	2.14	-	2.01
Sample Size	53	17	-	43
at Age 2	115.00	104.00	-	166.33
Std. Dev.	1.41	7.35	-	16.74
Std. Error	1.00	3.67	-	6.83
Sample Size	2	4	-	6
Age 1 (%)	96	81	-	88
Age 2 (%)	4	19	-	12
Sample Size	55	21	-	49
Mean Weight (g)	11.60	11.55	10.61	37.09
Std. Dev.	3.04	3.41	1.83	10.41
Std. Error	0.28	0.44	0.35	1.47
Sample Size	120	61	27	50
Weeks During which Samples Taken	2, 3, 4 & 5	1 & 2	1	2 & 3